



Evaluation of different modeling approaches to simulate contaminant transport in a fractured limestone aquifer

Mosthaf, Klaus; Broholm, Mette Martina; Bjerg, Poul Løgstrup; Binning, Philip John

Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Mosthaf, K., Broholm, M. M., Bjerg, P. L., & Binning, P. J. (2014). *Evaluation of different modeling approaches to simulate contaminant transport in a fractured limestone aquifer*. Poster session presented at 2014 AGU Fall Meeting, San Francisco, CA, United States.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



Evaluation of different modeling approaches to simulate contaminant transport in a fractured limestone aquifer

Klaus Mosthaf (klmos@env.dtu.dk), M.M. Broholm, P.L. Bjerg and P.J. Binning
DTU Environment, Technical University of Denmark

Introduction and objectives

It is important to understand the fate and transport of contaminants in limestone aquifers because they are a major drinking water resource in Denmark.

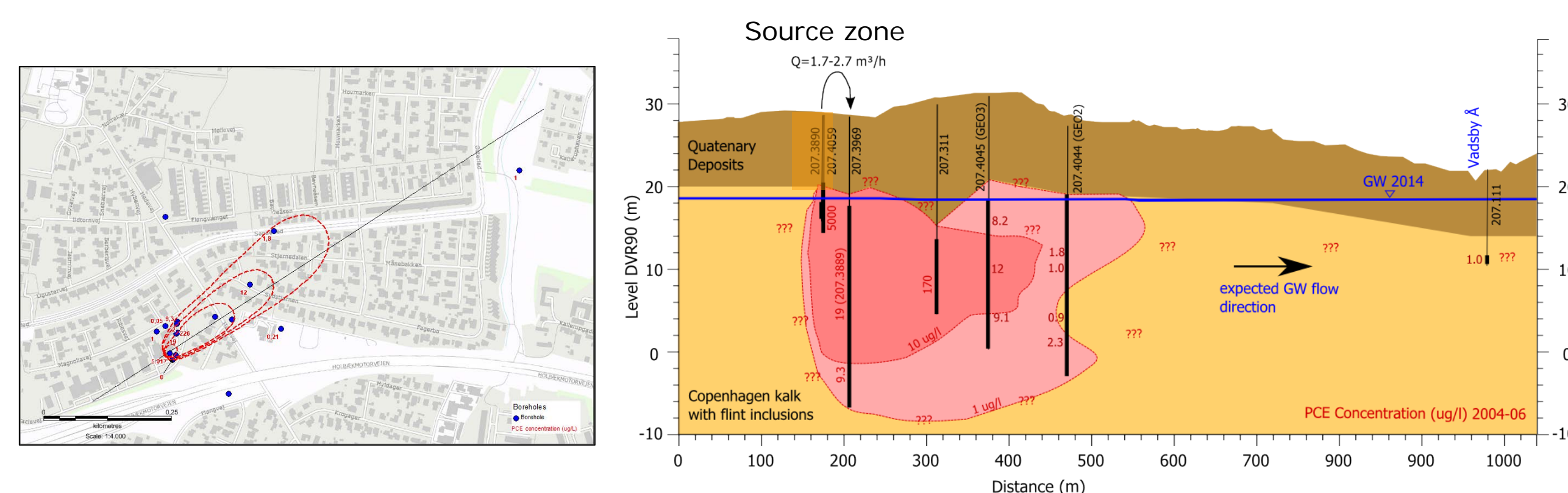
Several modeling approaches have been developed to describe solute transport in fractured media. However, these modeling concepts are not well tested for fractured limestone geologies.

The objective is to develop the modeling tools that are needed to simulate contaminant transport in fractured limestone aquifers

- Improve risk assessment and remediation design
 - Provide knowledge of the processes affecting the field scale behavior of contaminant plumes, e.g. fracture flow and back diffusion from the matrix
 - Provide the means to interpret lab and field data
 - Provide input to experimental and monitoring design
- Tight coupling between modeling and field work

Site description

- Contaminated site in Denmark: PCE spill in the 1970s (dry cleaner facility)
- Excavation of most contaminated area in 2006
- Installation of pump-and-treat system
- Currently: new measurements and new monitoring boreholes



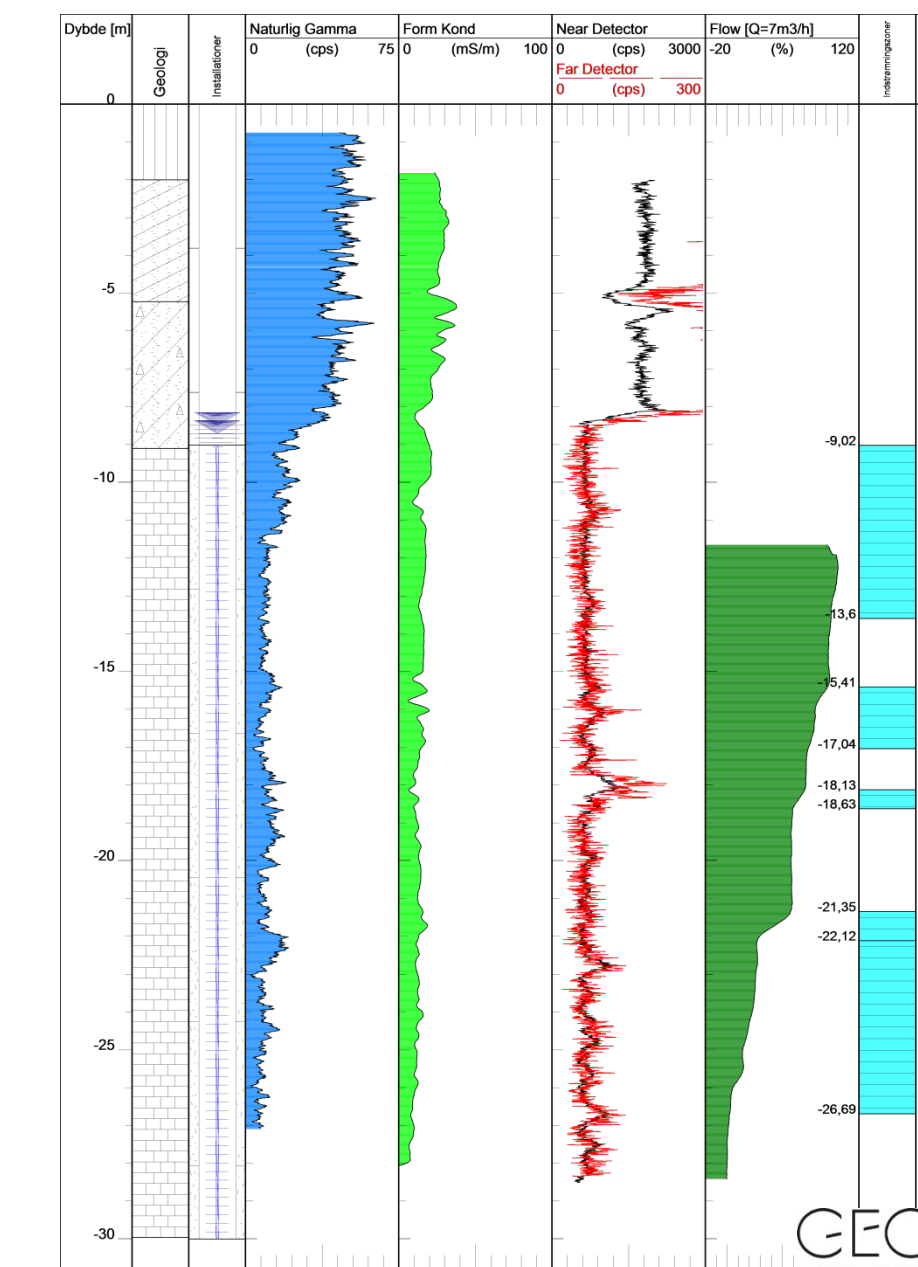
Geology

- Strongly heterogeneous
- Fractured limestone
- Flint inclusions

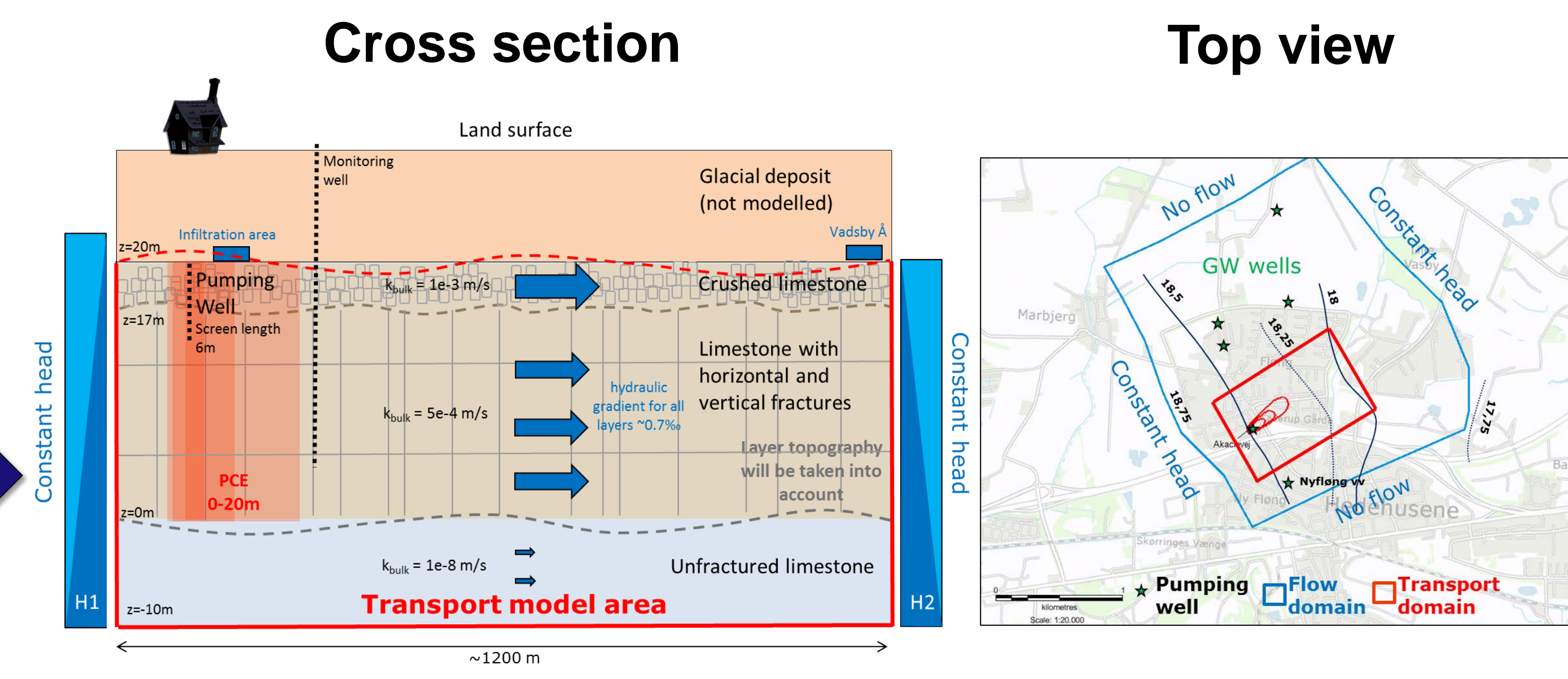


Data and measurements

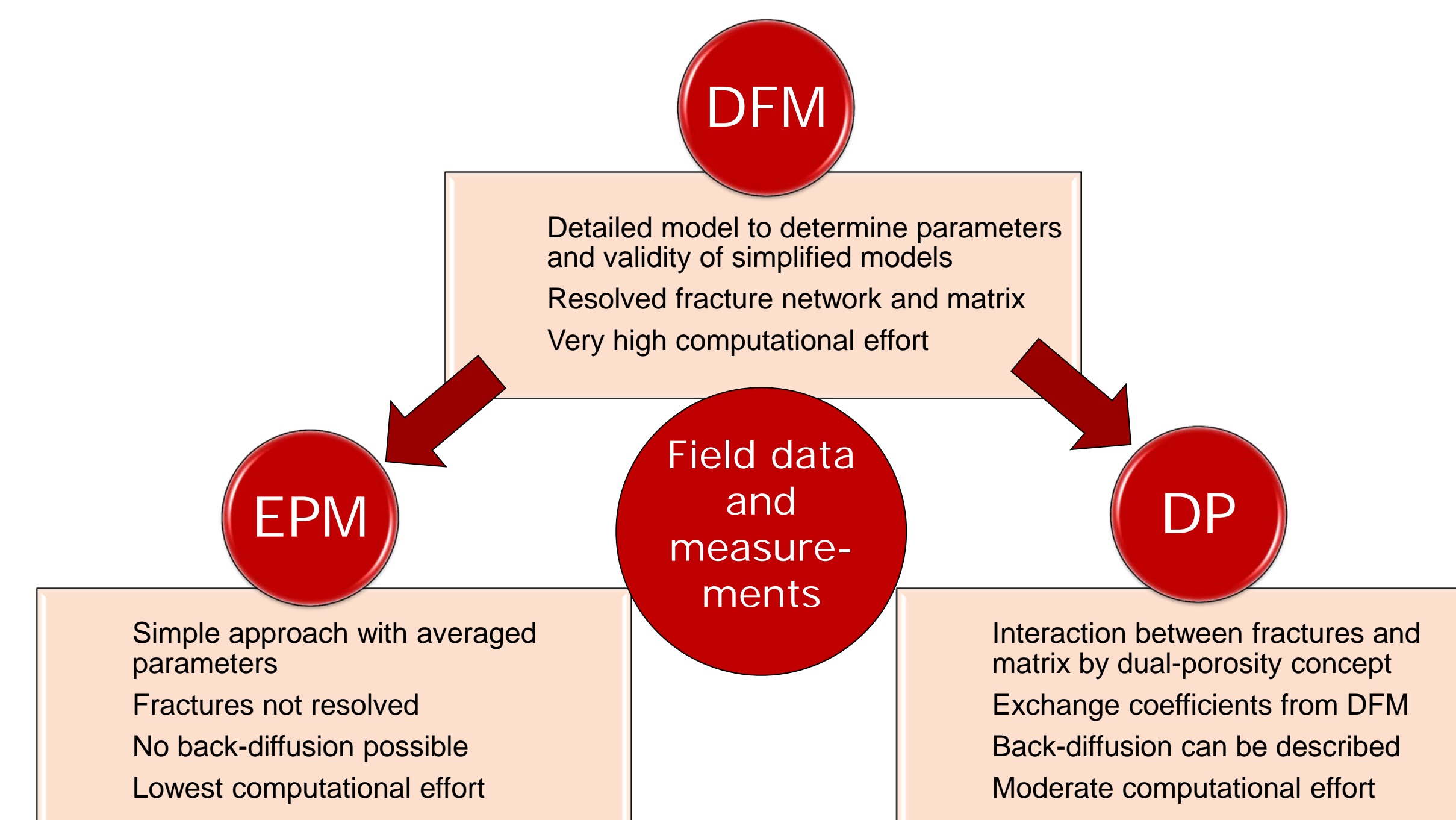
- Borehole logs, groundwater potentials
- Cores from boreholes
- Pump and slug tests
- Multilevel sampling of GW for contaminant analysis
- Fracture data from outcrops and boreholes
- Existing data (e.g. reports)



Conceptual model



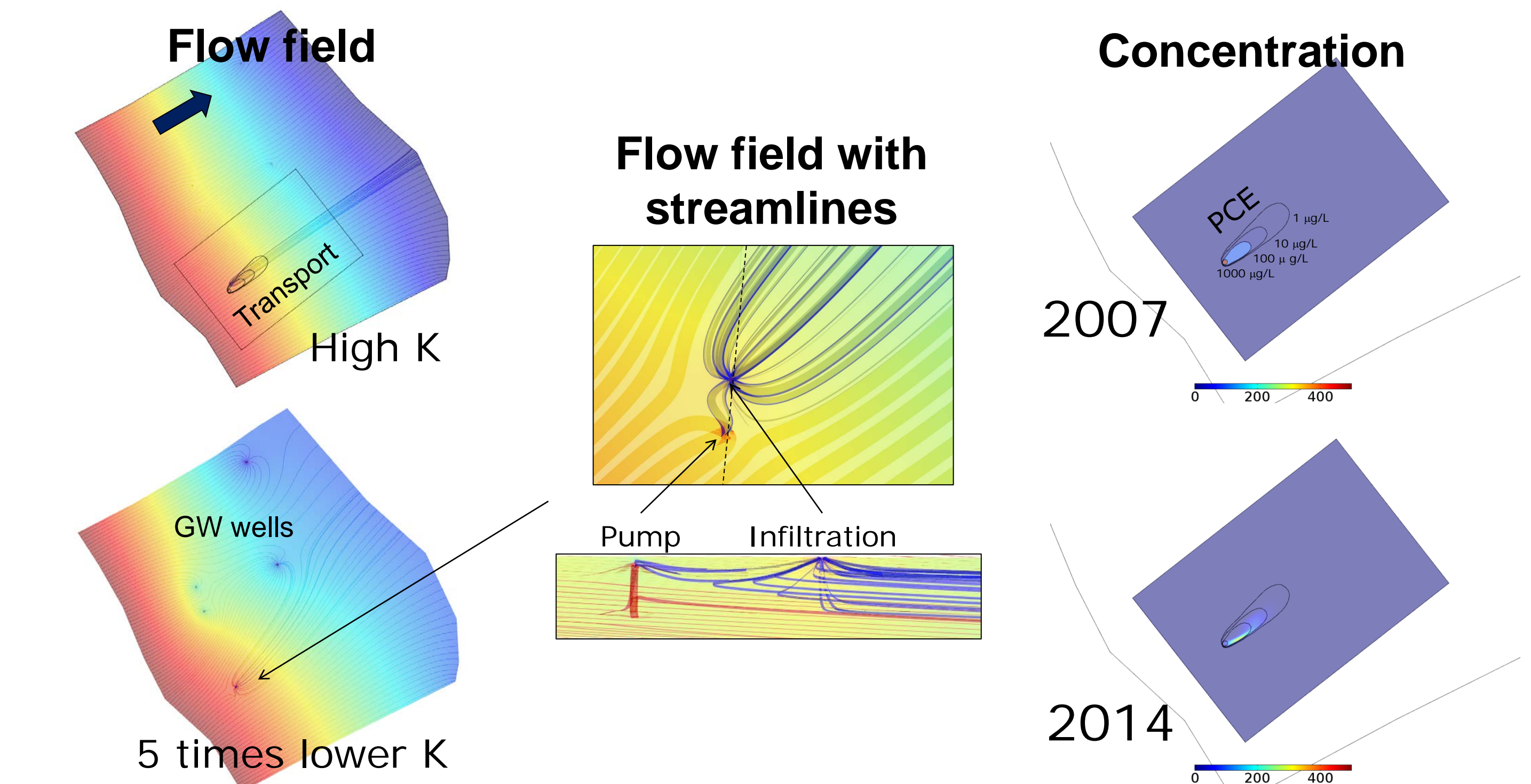
Numerical Models



Why is this challenging?

- High spatial variability, difficult to acquire aquifer parameters on right scale
- Complex geology and geometry has to be integrated in model
- Little knowledge of contaminant distribution
- Concentrations from water sampling represent high-conductive zones (fractures), concentrations from fractures and matrix required
- 3D modeling to analyze transport behavior (dispersion, fracture flow)
- High conductivity contrast between fractures, limestone and flint → very fine grid required for DFM
- Stability of numerical solution
- Determination of effective parameters (conductivity, porosity, dispersivity etc.) for EPM and DP models

Preliminary modeling results – EPM



Current and future work

- 3D EPM implemented in Comsol Multiphysics with nested domains
- Flow field includes important features in the domain
- Smaller transport domain to reduce computational effort
- Modeling used for experimental and monitoring design
- Comparison with field data and model evaluation

Future work

- Integration of new measurements (e.g. flow logs)
- 3D DFM simulations with representative fracture network in part of the domain to determine parameters for EPM / dual porosity model
- Testing and comparison of currently used models for their applicability and limitations to describe contaminant transport in fractured limestone aquifers
- Testing and comparison of different modeling tools
- Analysis of plume behavior, remediation efficiency and alternatives